1,119,710

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,119,710

Date of Application and filing Complete Specification: 23 Sept., 1966.
No. 42612/66.
Application made in Germany (No. D48430 Ic/27b) on 15 Oct., 1965.
Complete Specification Published: 10 July, 1968.

Index at acceptance: —F1 N(2E, 2G1A1)
Int. Cl.: —F 04 b 39/00

COMPLETE SPECIFICATION

Improvements in or relating to Compressors of the Reciprocating Piston Type

We, DANFOSS A/S, a Danish Company, of Nordborg, Denmark, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a compressor of the reciprocating piston type for small refrigerating units, including a valve plate including the suction and pressure valve seats and, arranged on either side thereof, unilaterally clamped flat springs which act as moving valve elements, the flat spring forming part of the suction valve being clamped between the valve plate and the cylinder end face.

Piston-type compressors of this type are usually very small, their cylinder diameter being only a few centimeters, for example 3cm. For this reason it is very difficult to accommodate the suction valve as well as the pressure valve within the cylinder head region. Only valves with flat springs have been successful.

However, flat springs of known shape suffer from the disadvantage that the valve apertures have to be arranged assymetrically within the cross-sectional plane of the cylinder; in other words, the suction valve aperture is located on one side, and the pressure valve aperture on the other side of a radial plane. As a result the thermal load placed on the valve plate is not symmetrical, and this may lead to undesirable temperature peaks. Moreover, during the pressure stroke, part of the gas has to traverse a larger distance to reach the pressure valve port; consequently, the gas speeds become non-uniform and undesirably high.

According to the present invention there is provided a compressor of the reciprocating piston type for small refrigerating units including a valve plate having a pressure valve seat located about the cylinder axis and one or more suction valve seats located on a circular locus adjacent the cylinder wall, valving being provided by means of a pair of unilaterally clamped flat springs bearing on opposite sides if the plate, the suction valve spring being clamped between the valve plate and the cylinder end face and having an annular obturating region and at least one outwardly extending mounting lug.

In this construction the pressure valve port is in the centre of the cylinder. This point can be reached equally well from all parts of the cylinder cross-section. Excessive discharge speed are thereby avoided. Moreover, the hottest point is in the centre of the valve plate, so that a substantialy symmetrical temperature distribution is achieved. A further advantage is the possibility of arranging the suction valve ports on either side of the pressure valve port whereby a symmetrical cooling effect is produced.

It is true that both the valve have already been designed as concentric annular valves in the case of large piston-type compressors, the closing elements of the valves executing a vertical reciprocating movement in suitable guides. However, constructions of this kind have not been applied to small-size piston-type compressors because such expensive designs are unsuitable for small piston-type compressors if only for economic reasons and, moreover, there is not sufficient space available for their installation.

In a preferred embodiment of the invention the pressure valve seat is of elongated formation and the two suction valve seats are arranged symmetrically about its longitudinal axis. However, instead of an elongated pressure valve seat, several, for example three, circular bores may be arranged beside one another. In this way comparatively

[*Price 4s. 6d.*]

large valve ports are obtained while the thermal stress placed upon the valve plate remains symmetrical, these large valve ports contributing towards minimum gas flow velocities.

The flat pressure valve spring may be of strip-shaped formation, in a manner known *per se*, and be held at both ends. A beam-type valve of this construction has already proved satisfactory. However, valves of this type have always had to be arranged eccentrically. According to the present invention such a valve may be situated symmetrically in a radial plane.

The annular part of the flat suction valve spring may also be connected integrally by its mounting lug or lugs to a plate covering the cylinder head. This plate may serve as a gasket. Moreover, a plate of this kind is easy to mount.

It is also feasible to provide the annular portion of the flat suction valve spring with two apertured mounting lugs that can be located over support pins passing through the valve plate and, at the other end, supporting the flat pressure valve spring. The provision of common mounting elements for the flat suction and pressure valve springs has hitherto not been possible, owing to their mutually displaced positions.

In a further development of the invention a flat clamping spring, is interposed between the compressor cylinder head and the flat pressure valve spring in known manner, the clamping spring being arched in bridge-like manner, and having its fastening holes in the non-loaded condition spaced apart from one another less far than the support pins. Since the flat clamping spring can be fitted with a certain amount of pre-stressing, it operates as a clamping device during assembly. This clamping action is eliminated automatically when the valve lid is applied and pre-stresses the flat clamping spring to the required extent.

Further details of the invention will now become apparent from the following description of several of its embodiments, with reference to the accompanying drawings, of which:

Figure 1 is a section through the cylinder head of a piston-type compressor according to the invention,

Figure 2 is a cross-section along the line A—A of Figure 1,

Figure 3 is a cross-section along the line B—B of Figure 1,

Figure 4 is a first embodiment of a flat suction valve spring,

Figure 5 is a second embodiment of a flat suction valve spring,

Figure 6 is a third embodiment of a flat suction valve spring, on a scale smaller than the foregoing Figures; and

Figure 7 is a fourth embodiment of a flat suction valve spring, illustrated on the same scale as Figure 6.

A piston 2 is capable of a reciprocating movement in a cylinder 1. On both sides of the cylinder are suction-silencing chambers 3, 4. On its end face the cylinder 1 is covered by a valve plate 6, a gasket 5 being interposed, the plate having an aperture 7 extending in its medial plane and a corresponding pressure valve seat 8, as well as ports 9, 10 bi-laterally arranged on an annular surface, with corresponding suction valve seats 11, 12, two ports 13, 14 leading to the suction valve chamber 3, 4, and a port 15 for the discharge of the compressed gas. A cylinder head 17 is placed on the valve plate 6, a gasket 16 being interposed there-between, the cylinder head forming two suction valve chambers 18, 19 and one pressure valve chamber 20. The components 1, 6 and 17 are connected to one another by screws 21.

Pins 22, 23 pass through the valve plate 6 and engage suitable bores in the cylinder 1 and cylinder head 17. The pressure valve is designed as a beam-type valve known *per se* and provided with a flat pressure valve spring 24, a stop plate 25 and a clamping spring 26. The latter is arched in the manner of a bridge and has two holes which engage the pins 22, 23 and are spaced less far apart from one another in the non-loaded condition than are the pins themselves. Therefore, these holes exercise a clamping action on the pins even when the clamping spring 26 is loosely placed on the pins. The spring 26 thus provides clamping action during assembly. This clamping action is automatically eliminated when the valve lid 17 is assembled and prestresses the spring 26. The three components 24—26 preferably have fastening slots rather than circular bores, at one end to allow a certain degree of compensation of dimensional inaccuracy.

Figures 1—3 show an arrangement in which a flat suction valve spring 27 according to Figure 4 has been employed. It consists of an annular portion 28, terminating on both sides in mounting lugs 29, 30. The fastening holes provided in these lugs engage the pins 22, 23. It is easily apparent that, due to this annular shape, a large central portion has been left open in which a pressure valve of large cross-section may be provided. On the other hand, the cross-section of the suction valve is also large, because the two valve seats 11, 12 are situated near the cylinder wall and their cross-sectional area is large even if the width of the slot-like ports 9, 10 is small.

The embodiment of Figure 5 comprises a flat suction valve spring 31 with an annular portion 32 and, at one end only, a mounting lug 33 with two fastening holes designed to engage two adjacent pins 34, 35, whereas the spring is provided on the other side with a

projection 36 acting as a stroke-limiting catch.

Figure 6 shows a flat suction valve spring 37 whose annular portion 38 is likewise provided with one fastening lug 39 and a stroke-limiting catch 40 on the other side. In this embodiment, however, the lug 39, and thus the whole flat suction valve spring is integral with a plate 41 extending over the entire cross-section of the cylinder end face which plate is accordingly provided with a number of apertures needed for the passage of the fastening screws 21, and also with the ports 13—15 of the valve plate. This type of suction valve is fixed and centred sufficiently well by the screws 21, so that no further fastening means are needed.

In the embodiment of Figure 7 a flat suction valve spring 42 is provided whose annular portion 43 is connected to a plate 46 covering the cylinder end face, by means of two mounting lugs 44, 45. Moreover, two stroke-limiting projections 47, 48 are provided on the annular portion 43.

WHAT WE CLAIM IS:—

1. A compressor of the reciprocating piston type for small refrigerating units including a valve plate having a pressure valve seat located about the cylinder axis and one or more suction valve seats located on a circular locus adjacent the cylinder wall, valving being provided by means of a pair of unilaterally clamped flat springs bearing on opposite sides of the plate, the suction valve spring being clamped between the valve plate and the cylinder end face and having an annular obturating region and at least one outwardly extending mounting lug.

2. A piston-type compressor as claimed in Claim 1, in which the pressure valve seat is of elongated formation and two suction valve seats are arranged symmetrically about its longitudinal axis.

3. A piston-type compressor as claimed in Claim 2, in which the flat pressure valve spring is of strip-shaped formation and is held at both ends.

4. A compressor as claimed in any one of Claims 1 to 3, in which the annular region of the suction valve spring is integrally connected by means of its mounting lug or lugs to a plate clamped between the valve plate and the cylinder end face.

5. A piston-type compressor as claimed in any one of Claims 1 to 3, in which the annular portion of the flat suction valve spring is provided with two apertured mounting lugs located over support pins passing through the valve plate and supporting at the other end the flat pressure valve spring.

6. A piston-type compressor as claimed in Claim 5, in which a flat clamping spring is interposed between the compressor cylinder head and the flat pressure valve spring, the clamping spring being arched in bridge-like manner and having fastening holes spaced apart less far from one another in the non-loaded condition than are the support pins.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1968.
Published by the Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

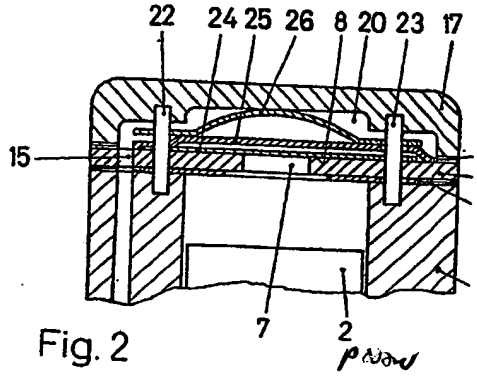

Fig. 2

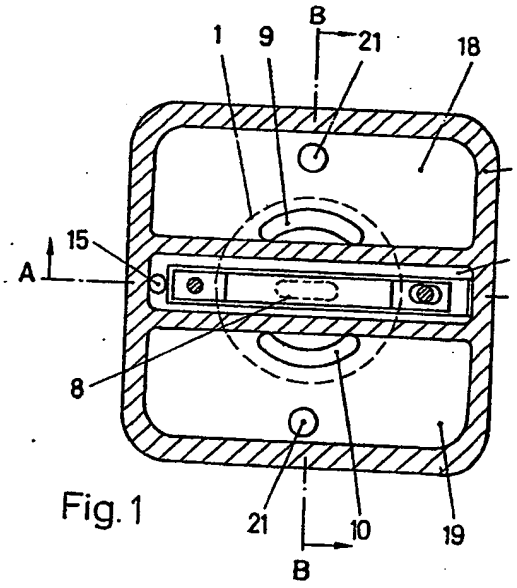

Fig. 1

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

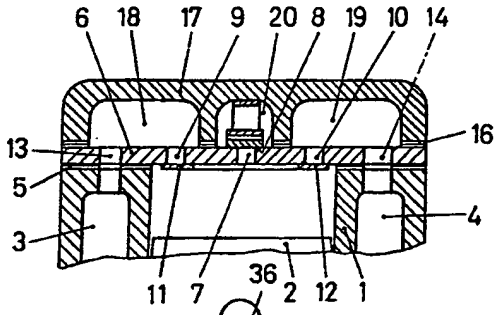

Fig.3

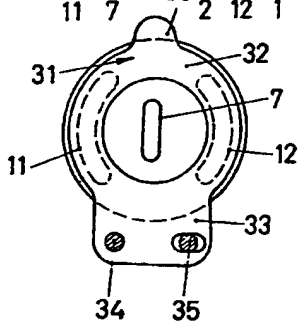

Fig.5

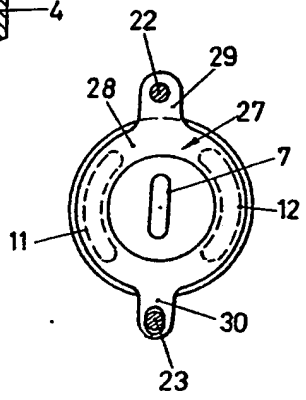

Fig. 4

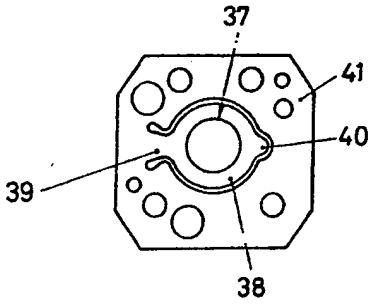

Fig.6

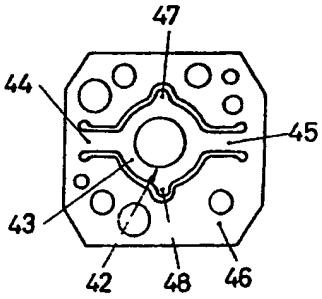

Fig. 7

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

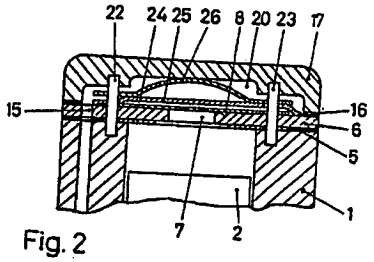

Fig. 2

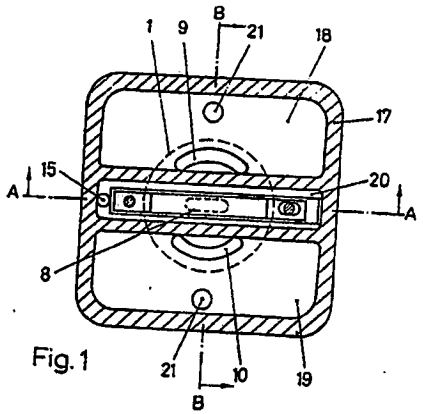

Fig. 1

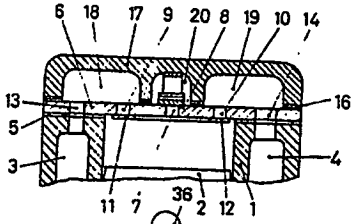

Fig.3

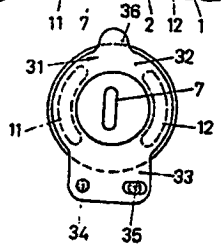

Fig.5

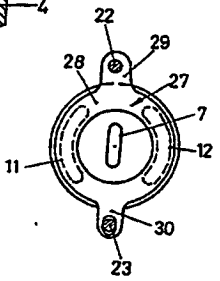

Fig. 4

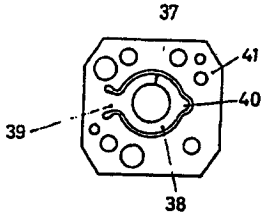

Fig.6

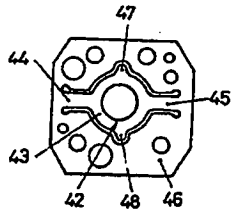

Fig. 7